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Nitrogen oxides at the UTLS: Combining observations from research aircraft and in-service aircraft

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Nitrogen oxides have a decisive influence on the chemistry of the upper troposphere and lower stratosphere. They are key constituents of several reaction chains influencing the production of ozone. They also play an essential role in the cycling of hydroxyl radicals and therefore influence the lifetime of methane. Due to their short lifetime and their variety of sources there is still a high uncertainty about the abundance of nitrogen oxides in the UTLS.
Dedicated aircraft campaigns aim to study specific atmospheric questions like lightning, long range transport or aircraft emissions. Usually, within a short time period comprehensive measurements are performed within a more or less restricted region. Therefore, especially trace constituents like nitrogen oxides with short lifetime and a variety of different sources are not represented adequately. On the other hand, routine measurements from in-service aircraft allow observations over longer time periods and larger regions. However, it is nearly impossible to influence the scheduling of in-service aircraft and thereby time and space of the observations. Therefore, the combination of dedicated aircraft campaigns and routine observations might supplement each other.
For this study we combine nitrogen oxides data sets obtained with the IAGOS-CARIBIC (Civil Aircraft for the Regular Investigation of the Atmosphere Based on an Instrument Container) flying laboratory and with the German research aircraft HALO (High altitude and long range research aircraft). Data have been acquired within the IAGOS-CARIBIC project on a monthly base using a Lufthansa Airbus A340-600 since December 2004. About four flights are performed each month covering predominantly northern mid-latitudes. Additional flights have been conducted to destinations in South America and South Africa. Since 2012 HALO has been operational. Nitrogen oxides measurements have been performed during six missions covering mid latitudes, tropical as well as Polar Regions. With HALO data can also be obtained at altitudes above the flight levels of commercial airliners. First results combining the nitrogen oxides data sets of both platforms are shown, analysing the temporal and regional distribution of nitrogen oxides at the UTLS.